Lake Erie Fisheries Assessment Unit
Report 1984-2

The Rainbow Smelt Fishery of Point Pelee National Park 1983

Ontario
Ministry of Natural Resources
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INTRODUCTION

Rainbow smelt, Osmerus mordax, first appeared in Lake Erie in 1935 originating from plantings in Lake Michigan tributaries in the early 1900's (Van Oosten 1937). After establishing populations in Lake Michigan, they spread to Lakes Huron, Superior and eventually Erie (Scott and Crossman 1973).

Since their relatively recent arrival, rainbow smelt have risen to first place, by weight, of all species harvested in Lake Erie; approximately 14 million kilograms (30 million pounds) were landed from commercial fish trawls in Ontario waters during 1981 (OMNR 1983).

These schooling, pelagic fishes inhabit most of the areas of Lake Erie sometime during their life cycle: young-of-the-year smelt use inshore areas (less than 18 m) for several months after hatching in the spring, yearlings are found both inshore and offshore, and, except for the spring spawning period, adults (two year old fish and older) are generally found offshore (greater than 18m) (MacCallum and Regier 1970).

Sport fishing for smelt on Lake Erie generally occurs in April or early May when adult smelt seek out streams and beaches on which to spawn (MacCallum and Regier 1970; Ferguson 1965; Regier 1962 a,b). Although a number of streams on the north shore and in Pennsylvania have spawning runs (Regier 1962b), spawning runs have always been stronger on north shore beaches (MacCallum and Regier 1970).

At Point Pelee National Park (PPNP), sport fishing for smelt first occurred in 1948 (Knight 1974); however, this fishery was not surveyed until 1957 (Roseborough 1962). This fishery had reached a significant level in 1959 when 128,245 smelter-hours of fishing effort produced a harvest of 1,165,326 kg (2,569,106 lb) of smelt (Roseborough 1959).

In 1983, the Ontario Ministry of Natural Resources in cooperation with Parks Canada staff at PPNP conducted a survey to define the current characteristics of this sport fishery. The objectives were to:

1. estimate the size of the harvest, amount of fishing effort, and fishing success rates.
2. describe the biology of the spawning population relating spawning activity to ambient environmental conditions.
3. profile the user-group focusing on origin, visitor-type, frequency of trips and the type of gear fished.

POINT PELEE NATIONAL PARK

Point Pelee National Park (41°54' N latitude, 82°31' W longitude) is along the north shore of Lake Erie (Fig. 1). It is a 1594-hectare spit of sand which is situated on a foundation of Eastport sand, silt and gravel and is composed mainly of 1011 hectares of marshland enclosed by a perimeter of deciduous forests and 22.5 km of sand and pebble beaches (Parks Canada 1982).

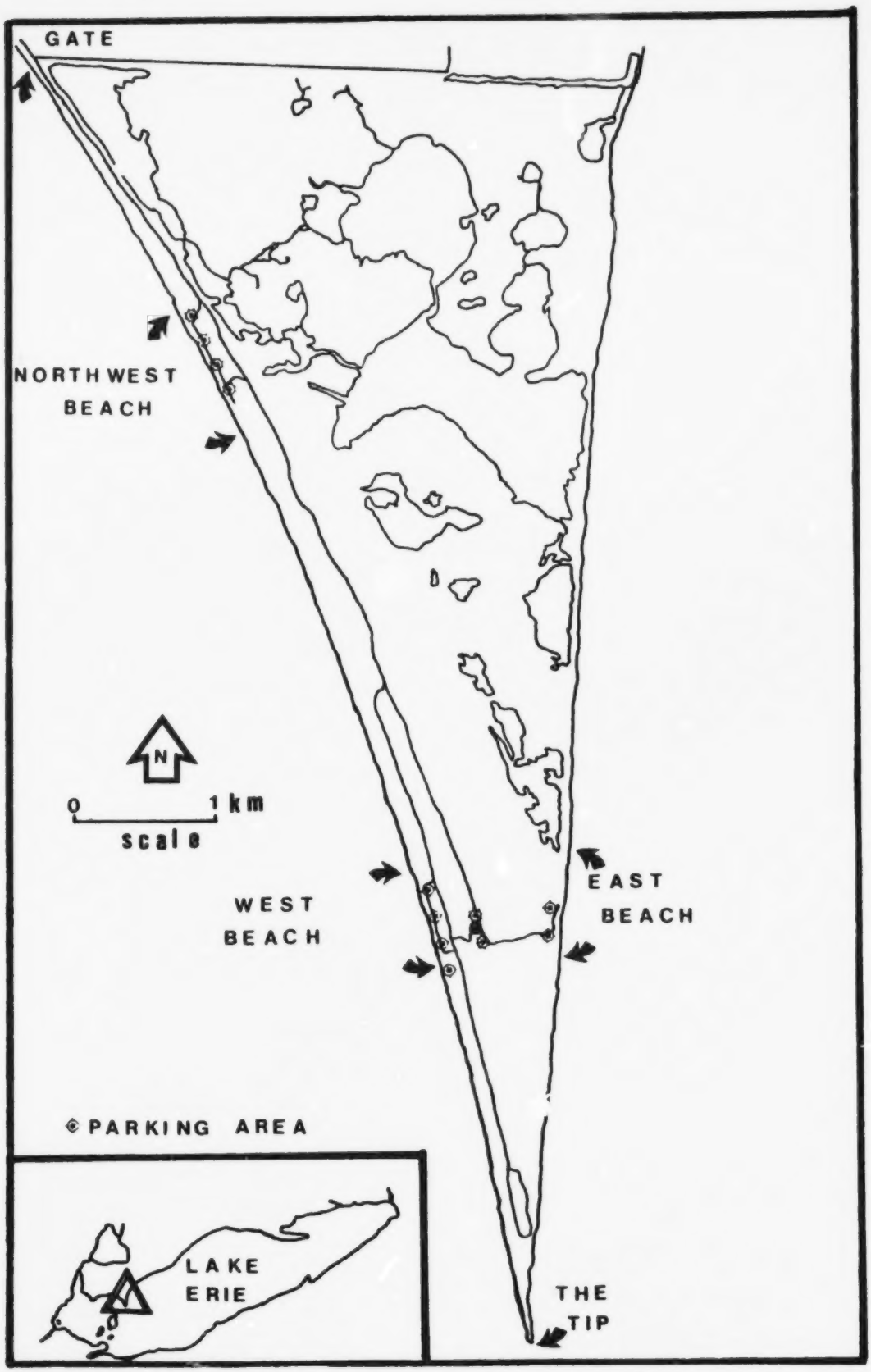

Figure 1. Major smelt fishing areas at Point Pelee National Park, 1983.

METHODS

For the purposes of this report, a smelter is defined as a member of a group of people which fished for smelt. As a member of the group, he may not have fished actively himself, i.e., handled the fishing gear, however, he probably assisted in the secondary phases of fishing such as picking and carrying and thus contributed to the overall fishing process.

On alternate evenings from April 7 through April 27, 1983, a roving, complete-trip creel census was conducted in the parking areas adjacent to the major beaches at PPNP (Fig. 1). Smelters fishing at the tip were transported via a commuter system from a parking area at the Interpretive Centre (located approximately 100 m east of the West Beach parking area) to a refreshment centre approximately 400 m from the tip. The evening survey periods were from 2000 to 2400 h, the period when most smelters stopped fishing for the evening.

A two-person survey crew operated out of a pickup truck equipped with platform weigh scales, accurate to ± 1.0 lb (0.454 kg), for weighing catches. At 2000 h on each scheduled date, the survey crew, obtained an instantaneous count of smelter vehicles present in the park from personnel at the park gate. Then, they drove through the park tallying vehicles and origin of vehicles (as determined by license plates) in each of the four parking areas. These counts provided a relative distribution of vehicles among the four parking areas on

that evening and this distribution was used to proportionally allocate sampling effort (Appendix Table A.1).

Next, the survey crew visited each parking area and interviewed smelters who had completed their fishing trip. Several trips were made to each parking area during the survey period.

Samples of rainbow smelt were obtained from smelters on one evening in each of the early, middle and late stages of the smelt run.

The survey crew obtained daily records of the numbers of vehicles which had entered the park during the 1500 to 2200-h work shift from personnel at the park gate. Gate personnel monitored incoming traffic at selected intervals during the 1500 to 2200-h period (vehicles were not allowed to enter after 2200 h) to obtain the proportion of smelter vehicles. Total counts of vehicles were obtained from a pressure-sensitive electronic vehicle counter. The daily number of smelter vehicles which had entered the park was calculated by multiplying the total number of vehicles which had entered the park during the 1500 to 2200-h period by the observed proportion of smelter vehicles.

The estimated harvest ($\hat{H}$) in kilograms, and the estimated fishing effort ($\hat{E}$) in smelter-hours were calculated as follows:

$$\hat{H} = \frac{V}{\bar{v}} \times \bar{h}$$

$$\hat{E} = \frac{V}{\bar{v}} \times \bar{e}$$

where;

V = the total number of smelter-vehicles which entered the park

$\bar{v}$ = the sample mean number of vehicles per smelter party

$\bar{h}$ = the sample mean weight of smelt harvested per smelter party

$\bar{e}$ = the sample mean fishing effort exerted per smelter party

Water temperatures were taken by the survey crew at each of the East and West Beaches on each scheduled evening. Meteorological information was obtained from the nearest weather station at Windsor, Ontario, approximately 55 km away (Appendix Table A.2).

Survey methods in 1959 and 1983 were similar with respect to complete trip interviews and vehicle counts permitting comparisons between the two years.

RESULTS AND DISCUSSION

Harvest and Fishing Effort

There were an estimated 407,402 kg (898,168 lb) of rainbow smelt harvested and an estimated 71,298 smelter-hours of fishing effort exerted in PPNP in 1983. This is derived from figures in Table 1 and is based on interviews with 194 smelter parties (3.7% of the total) which caught an estimated 78.3 kg (S.D. = 171.4 kg) of smelt per party and exerted an estimated 13.8 smelter-hours (S.D. = 12.65 smelter-hours) per party.

In 1983, fishing effort, expressed as the total number of smelters, had declined by 21% from the annual mean for the 1977 to 1982 period, and by 42% from that of 1959 (Table 2). In 1959, there were no curfews or entry limits on the number of cars permitted into the park at any given time; for example, 8000 cars visited the park on the peak weekend in 1962 (Regier 1962 a). In 1974, a 1400-car limit and restricted entry at 2200 h were imposed on smelters. This was followed by 1100-, 1000-, and 800-car limits during the 1975-81, 1982, and 1983 periods respectively (L. Meleg, pers. comm.). Although it appears that entry limits decreased fishing effort during the 1977 to 1982 period from 1959, this regulation probably did not affect the 1983 effort as there was only one night (April 22) on which the 800-car limit was realized (Table 1). In 1983, unfavourable weather conditions and a low abundance of smelt in the spawning run probably deterred potential smelters.

Table 1 . Summary of smelt fishery statistics at Point Pelee National Park, 1983.[a]

Date	Total vehicles (number)	Smelter vehicles (number)	Smelters (number)	Number of smelter-parties interviewed	Number of smelters/ smelter-party	Number of vehicles/ smelter-party	Observed effort (smelter-hours)	Observed harvest of smelt (kg)	Kilograms of smelt/ smelter-hour
April 7	163	78	257	1	5.0	1.0	12.5	25	2.0
April 8	276	138	455	-	-	-	-	-	-
April 9	200	88	290	1	4.0	1.0	12.0	1	0.1
April 10	610	177	584	-	-	-	-	-	-
April 11	221	133	439	6	3.0	1.2	46.5	208	4.5
April 12	365	227	749	-	-	-	-	-	-
April 13	349	236	779	15	3.9	1.2	157.4	583	3.7
April 14	320	260	858	-	-	-	-	-	-
April 15	487	409	1,350	25	5.0	1.5	318.0	3,354	10.6
April 16	1,118	648	2,138	-	-	-	-	-	-
April 17	263	138	455	8	5.8	1.5	102.0	792	7.8
April 18	159	84	277	-	-	-	-	-	-
April 19	250	135	446	11	4.5	1.2	89.1	1,565	17.6
April 20	389	263	868	-	-	-	-	-	-
April 21	714	558	1,841	35	4.6	1.2	421.5	3,720	8.8
April 22	1,141	886	2,924	-	-	-	-	-	-
April 23	1,346	626	2,066	41	5.7	1.5	773.9	2,287	3.0
April 24	1,215	360	1,188	-	-	-	-	-	-
April 25	508	358	1,181	21	4.2	1.2	279.7	646	2.3
April 26	842	602	1,987	-	-	-	-	-	-
April 27	540	361	1,191	30	4.4	1.2	445.4	2,008	4.5
Total	11,476	6,765	22,323	194	4.7	1.3	2,658.0	15,188	5.7

[a] Counts of total vehicles, smelter vehicles, and smelters are absolute values obtained from park visitation records (L. Meleg, pers. comm.).
Observed values for effort and harvest represent the sampled portion of the population only and are not total estimates.

Table 2. Number of vehicles and smelters counted during the smelt run at Point Pelee National Park, 1957-83.

Year	Period	Days (number)	Total vehicles (number)	Smelter vehicles (number)	Smelters (number)	Smelters/ day (number)	Source [a]
1983	April 7-April 27	21	11,486	6,765	22,323	1,063	PPNP
1982	April 13-May 1	19	17,360	9,844	30,303	1,595	PPNP
1981	April 16-May 2	17	14,190	9,205	30,271	1,781	PPNP
1980	April 18-May 4	17	17,351	10,130	30,390	1,788	PPNP
1979	April 20-May 6	17	15,236	9,480	28,430	1,672	PPNP
1978	April 14-April 30	17	13,372	8,993	26,979	1,587	PPNP
1977	April 15-May 1	17	12,607	7,408	22,224	1,307	PPNP
Mean [b]	1977-82	17 (0.8)	15,019 (2,009)	9,177 (960)	28,100 (3,184)	1,622 (177)	
1974	April 1-April 30	-	17,312	-	35,196	-	Knight (1974)
1960	- -	-	-	-	44,600	-	Roseborough (1962)
1959	April 13-April 27	15	10,730	-	38,628	2,575	Roseborough (1959)
1957	April 15-April 30	16	11,732	-	-	-	Bailey (1958)

[a] PPNP represents Point Pelee National Park visitation records (provided by L. Meleg)

[b] Standard deviations are in parentheses.

In addition, the park introduced a telephone "hotline" service whereby smelters could obtain up to date progress reports on fishing success prior to going fishing. Conceivably, this could have influenced smelters to postpone trips that they normally would have made until advised by the hotline that the run was peaking.

The 1983 harvest of 407,402 kg (898,168 lb) was 65% less than the 1,165,327 kg (2,569,106 lb) taken in 1959. This decline is explained in part by the 42% decrease in effort over the same period. Furthermore, a 40% reduction in mean harvest per smelter in 1983 from 1959 (18.25 kg vs 30.17 kg) suggests that smelt were not as available in 1983 as in 1959. The preceeding would apply if the mean length of a fishing trip and the mean size of individual harvest targets had not varied over time. Unfortunately, the 1959 data prevented testing these hypotheses.

Harvest Biometrics

Although the proportions of age groups in the harvest varied with sex, the majority of the harvest was composed of two-, three-, and four-year-old fish constituting 45, 20, and 27% of the harvest respectively (Table 3). The average smelt harvested was 155 mm (6.1 in) long and weighed 21 g (0.7 oz).

Timing and Duration of the Spawning Run

In 1983, the peak period of spawning, as determined by fishing success rates, occurred from April 15 to April 21 in waters from 5 to 6° C (Fig. 2). The peak

Table 3 . Age composition, average total length (mm) and weight (g) of rainbow smelt harvested at Point Pelee National Park, Lake Erie, 1983. n is sample size.

Sex	Parameter	Age-Group 2	3	4	5	6	ALL	n
Male	% Comp.	50	19	24	7	-		161
	Length	142	151	171	180	-	153	
	Weight	15	18	27	31	-	20	
Female	% Comp.	26	21	40	10	3		38
	Length	145	148	175	191	191	164	
	Weight	16	16	30	39	36	24	
Combined[a]	% Comp.	45	20	27	8	<1		199
	Length	142	151	172	183	191	155	
	Weight	15	18	28	33	36	21	

[a] The length/weight regression equation for both sexes is:

$$\log_{10} \text{WT (g)} = -5.4339 + 3.0685 \log_{10} \text{LTH (mm)}; \; r = 0.97$$

night occurred on April 19 when the water temperature was 5° C.

This survey and the fishery within PPNP occurred from April 7 to April 27 both coinciding with the period when specialized services were provided by PPNP staff to accommodate smelt fishermen. As a result, the beginning and end of the run were not subject to survey or fishing. As demonstrated by observed success rates (Table 1), the spawning run, for the most part, fell between the dates surveyed. Water temperature over the survey period ranged from 5 to 9° C ($\bar{t}$ = 6.3° C; S.D. = 1.42; n = 11).

Both the timing and duration of the spawning run in 1983 are consistent with observations by earlier workers. MacCallum and Regier (1970) noted that the smelt run at PPNP usually occurred in mid-April and lasted from one to two weeks. Regier (1962 a) examined records from various sources for the 1952 to 1962 period and found that the PPNP smelt run usually began after April 12 and ended before May 4 with the maximum number of smelters coming on the weekend closest to April 21. Toll (1959) indicated that the peak of the run in 1959 occurred on the weekend of April 21 - 22 and that the proportion of female smelt in the harvest on those dates was 40 - 50%. The maximum proportion of females in the harvest in 1983 (43%) occurred on April 21.

User-Group Characteristics

The average smelter party was composed of 4.7 people (11.6%$\leq$16 years of age) whose members had travelled

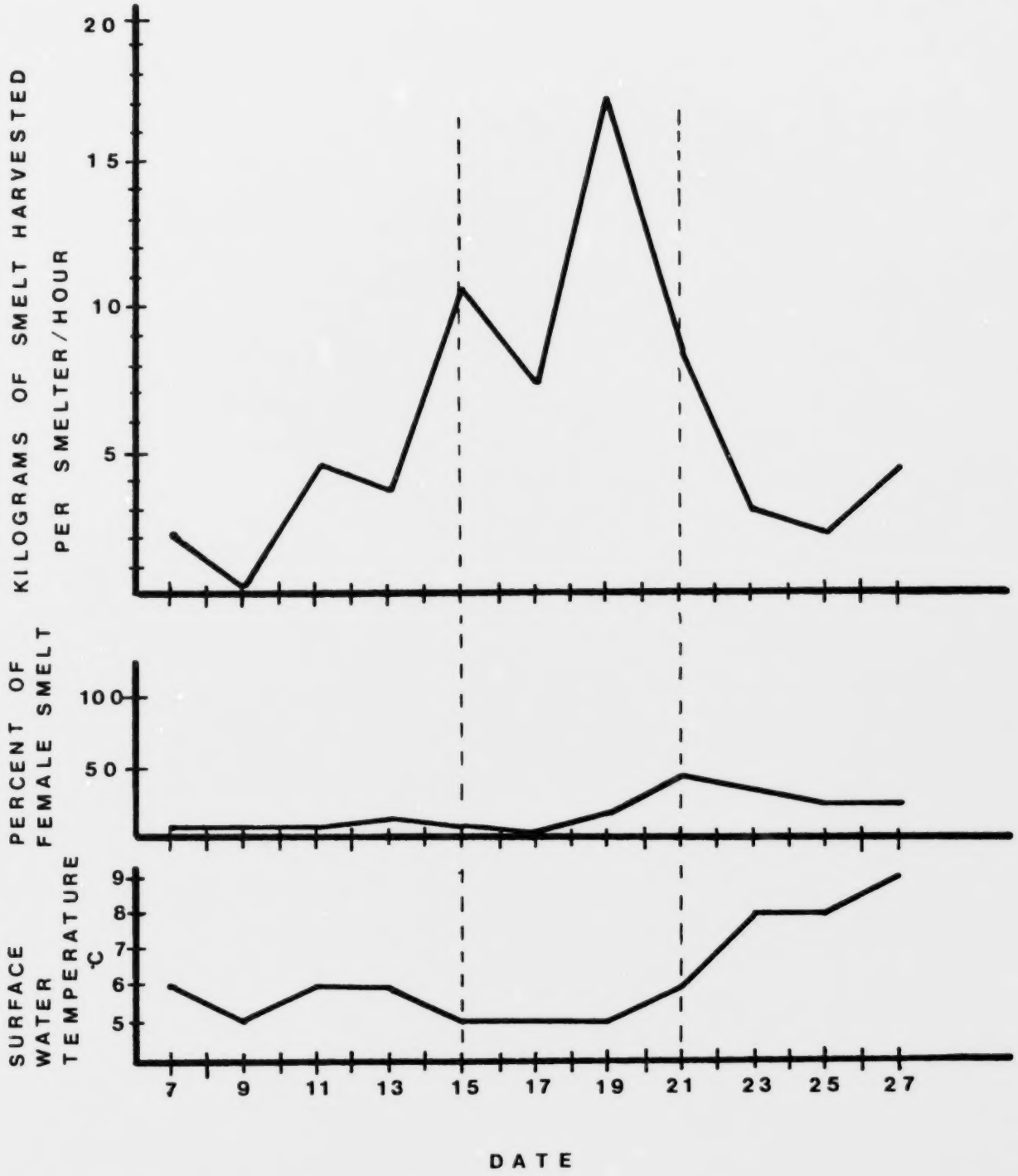

Figure 2. Daily variation in fishing success, proportion of female smelt in the harvest, and surface water temperatures, Point Pelee National Park, April, 1983.

Table 4 . Origin of smelters at Point Pelee National Park, 1983.[a]

Date	Origin					
	Michigan	Ohio	Ontario	Sub-total	Unknown[b] U.S.	Total
April 7	4	0	2	6	3	9
April 9	0	0	2	2	16	18
April 11	27	1	4	32	1	33
April 13	82	6	18	106	10	116
April 15	184	23	28	235	36	271
April 17	25	0	6	31	5	36
April 19	32	11	9	52	15	67
April 21	222	5	68	295	43[c]	338
April 23	433	42	51	526	167	693
April 25	141	8	29	178	42	220
April 27	106	2	36	144	26	170
Total	1,256	98	253	1,607	364	1,971
Percent (known)	78	6	16	100	-	-

[a] Tally of cars in all parking lots on initiation of survey at 2000 h.

[b] Determination of origin was not possible due to orientation of car and/or lack of anterior license plate.

[c] Includes one vehicle from each of Texas, Arkansas and Colorado.

in 1.3 vehicles (Table 1), fished for 2.8 hours (S.D. ± 1.13), and caught 78.3 kg of rainbow smelt or the equivalent of one 5-gal (U.S.) plastic pail per smelter.

Eighty-four percent of smelters were from the United States with 78% of those coming from Michigan; only 16% were residents of Ontario (Table 4). By comparison, 87% of the smelters in 1959 were from the United States (Toll 1959).

The majority (59%) of smelters originated within one hour's driving distance of PPNP with 82% originating within two hour's driving distance (Table 5).

Ninety-eight point five percent of smelters indicated that they would be returning home that evening after completing their fishing trip (Table 6).

Seventy-eight percent of smelters made one fishing trip to PPNP with 22% making multiple trips (Table 7).

Eighty-three percent of smelting parties only used one seine and 7% only used one dipnet (Table 8). The most popular length of seine was 20 feet.

Table 5 . Distance travelled by smelters from the point of origin to Point Pelee National Park, 1983.

	Distance (km)					
	0-16	17-96	97-193	194-290	>290	Total
Parties (number)	2	106[a]	41	24	9	182
Percent of Total	1	58	23	13	5	100
Cumulative Percent	1	59	82	95	100	-

[a] This figure includes 62 parties which had originated from the Cities of Windsor and Detroit.

Table 6. Visitor-type of smelters at Point Pelee National Park, 1983.

	Visitor-Type					
	Day-tripper	Commercial camper	Provincial Park camper	Private cottager	Paid accommodation	Total
Parties (number)	190	1	1	1	0	193
Percent of Total	98.5	0.5	0.5	0.5	0.0	100.0

Table 7 . Frequency of trips by smelters at Point Pelee National Park, 1983.

	Trip Frequency (number)						
	1	2	3	4	5	6	Total
Parties (number)	152	29	12	0	0	1	194
Percent	78	15	6	0	0	1	100

Table 8 . Smelt fishing gear used at Point Pelee National Park, 1983.

Gear	Parties (number)	Percent
6-foot seine only	3	1.6
8-foot seine only	2	1.0
10-foot seine only	16	8.3
12-foot seine only	24	12.4
14-foot seine only	1	0.5
15-foot seine only	21	10.8
16-foot seine only	4	2.1
18-foot seine only	3	1.6
20-foot seine only	48	24.7
22-foot seine only	1	0.5
24-foot seine only	5	2.6
25-foot seine only	4	2.1
27-foot seine only	2	1.0
30-foot seine only	27	13.9
Two or more sizes of seine	1	0.5
Dipnet only	13	6.7
Dipnet and seine	6	3.1
Unknown	13	6.7
Total	194	100.1

SUMMARY

1. There were 194 interviews (3.7% of total) conducted with smelting parties from April 7 to April 27, 1983.
2. The peak period of the smelt run extended from April 15 to April 21 in water 5 to 6° C with the peak night occurring on April 21.
3. An estimated 22,323 smelters exerted an estimated 71,298 smelter-hours of fishing pressure.
4. Smelters harvested an estimated 407,402 kg (898,168 lb) of rainbow smelt.
5. The 1983 harvest is 65% less than that estimated for 1959 due in large part to a 42% reduction in fishing effort and to a lesser extent by a decrease in the availability of smelt.
6. The harvest was mainly composed of two-, three-, and four-year-old fish constituting 45, 20, and 27% of the harvest respectively. The average smelt harvested was 155 mm (6.1 in) long and weighed 21 g (0.7 oz).
7. The average smelter party: constituted 4.7 people, travelled in 1.3 vehicles, fished for 2.8 hours, and harvested 78.3 kg of rainbow smelt or the equivalent of one 5-gal (U.S.) plastic pail per smelter.
8. Fifty-nine percent of smelters originated within one hour's driving distance of PPNP with 82% originating within two hour's driving distance.
9. Seventy-eight percent of smelters undertook one fishing trip to PPNP with the remainder making multiple trips.

10. Various lengths of seines only and dipnets only were used by 83% and 7% of smelting parties respectively.

ACKNOWLEDGEMENTS

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In addition, I am grateful to Sharon Barnes, Warren Dunlop, Jerry Paine, Mike Petzold, Debbie Schroeder, and Art Timmerman for assisting me with the field work. Sharon Barnes and Art Timmerman sampled fish and prepared scale samples for aging. The scale samples were aged by Nancy Drummond and Carol Seili typed the manuscript. Data were entered on the computer by Zennie Seguin. Statistical advice and computer analysis were provided by Mike Petzold and Bob Sutherland. An early draft of this manuscript was reviewed by Jerry Paine and Norm Smith.

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Appendix Table A.1. Distribution of vehicles at the beginning of the survey and the corresponding number of interviews which were conducted at Point Pelee National Park, 1983.

Date	Number of Vehicles					Number of Parties Interviewed				
	Northwest Beach	West Beach	Interpretive Centre (Tip)	East Beach	Total	Northwest Beach	West Beach	Interpretive Centre (Tip)	East Beach	Total
April 7	3	0	5	1	9	1	0	0	0	1
April 9	11	7	0	0	18	1	0	0	0	1
April 11	7	5	14	7	33	1	0	4	1	6
April 13	36	44	36	0	116	4	9	2	0	15
April 15	7	0	241	23	271	0	0	24	1	25
April 17	13	12	11	0	36	0	2	6	0	8
April 19	7	11	42	7	67	0	2	8	1	11
April 21	20	32	267	21	340	3	1	22	8	34
April 23	300	92	300	2	694	18	3	20	0	41
April 25	32	62	104	22	220	2	4	13	2	21
April 27	18	20	106	26	170	4	5	19	2	30
Total	454	285	1,126	109	1,974	34	26	118	15	193
Percent	23	14	57	6	100	18	13	61	8	100

Appendix Table A.2. Summary of water temperature and meteorological information, April, 1983.[a]

Date	Mean Air Temperature (°C)	Water Temperature East Beach (°C)	Water Temperature West Beach (°C)	Rainfall (mm)	Snowfall (cm)	Prevailing Wind Mean Speed (km/h)	Prevailing Wind Direction
1	5.4	-	-	0	0	18.9	E
2	5.2	-	-	11.4	0	30.6	E
3	6.9	-	-	1.2	0	11.2	S
4	5.5	-	-	Trace	0	13.6	W
5	5.5	-	-	5.0	0	9.9	E
6	5.4	-	-	6.4	0	14.5	E
7	7.7	6.0	6.0	6.4	0	10.9	W
8	4.1	-	-	0	0	15.6	NE
9	5.2	-	5.0	18.8	0	25.0	E
10	6.6	-	-	0.8	0	14.6	SSW
11	6.4	6.0	6.0	Trace	0	9.3	W
12	6.4	-	-	0	0	9.3	NE/ESE
13	9.4	6.0	6.0	11.2	0	22.3	SE/SSE
14	10.6	-	-	16.0	0	27.9	SE
15	2.8	5.0	5.0	0	Trace	16.6	SW
16	3.1	-	-	0	0.2	11.6	W/SE
17	-0.1	4.0	5.0	Trace	3.6	24.1	NNW
18	-1.6	-	-	0	Trace	14.7	N
19	0.2	5.0	5.0	0	0	12.3	N/NW
20	3.6	-	-	0	0	18.0	NW/WNW
21	7.5	6.0	6.0	0	0	20.1	WNW
22	7.6	-	-	0	0	4.4	E/ENE
23	8.8	8.5	-	0	0	18.2	NE
24	6.9	-	-	0	0	27.1	N
25	8.0	8.5	8.0	0	0	16.7	N
26	14.8	-	-	0.6	0	11.0	SSW
27	18.6	7.5	9.0	0	0	18.5	W
28	9.0	-	-	9.6	0	15.4	N
29	8.7	-	-	2.0	0	7.2	SE/SSE
30	11.2	-	-	19.0	0	11.3	S VRL[b]

[a] Mean air temperatures are from the hourly records of Environment Canada (Atmospheric Environment Service), Windsor Airport, Ontario. Other meteorogical data are from Monthly Meteorological Summaries at the same location.

[b] Variable